DRILLING TOOL COMPRISING A CUTTING ELEMENT THAT IS CONFIGURED AS A PLATE OR HEAD

The present invention relates to a drilling tool according to the definition of the species in Claim 1.

Publication DE 197 34 094 A1 makes known a rock drill that includes a cutting element that is configured as a plate and that has at least one cutting edge defined by a cutting face and a free face. The free face is defined by a first section with a small free face angle and a second section with a larger free face angle, in order to enhance the penetration of the rock drill into the material.

The object of the present invention is to provide a drilling tool with a cutting element that, in the region of the cutting edge, is optimal for penetration of the material to be worked, and that has an overall robust design.

This object is attained, according to the present invention, based on the features of the definition of the species in Claim 1 by the characterizing features of Claim 1. Advantageous refinements are described in the subclaims.

The drilling tool according to the present invention for percussion drilling in particular has a first free face section on the cutting edge that is limited by a convex bulge or a convex polygon outline as viewed in a cutting plane that is cut at a right angle to the cutting edge. The vertical height of a rib defined by this first free face section and an associated first cutting face section ranges from 0.1 mm to 1.0 mm This projecting design of the first free face section with the special dimensions of the projection ensures that the projection penetrates the material with little resistance and has a height that is greater than or equal to the depth of penetration of the drilling tool with a single impact. As a result, the drilling tool is prevented from being braked by the subsequent second free face section. Nor is it necessary to design the first section of the free face as a compromise between different requirements. The core of the present invention, therefore, is to design an aggressive cutting geometry tailored to the depth of

penetration by the drilling tool with a single impact while supporting the cutting surface in an optimum manner. In a 1/10 mm range, the cutting lip or the close range of the cutting edge defined by the cutting face and the first free face section is designed as a rib or an impact body that enables optimal penetration of the material with a high level of stability.

According to an advantageous design of the object of the present invention, the vertical dimension or height of the rib is designed to range from 0.1 mm to 0.5 mm in particular. In this range, the depth of penetration of drilling tools in concrete or stone typically has a diameter of up to 30 mm. Greater penetration depths are attained when the material is particularly soft, of course, which requires that the drilling tool be adapted accordingly.

In addition, an increase in the vertical height of the rib toward the longitudinal axis is provided. As a result, increased wear in the region of the longitudinal axis of the drilling tool can be accommodated, the increased wear resulting, e.g., from drilling into strongly reinforced concrete.

The present invention also provides for a drilling tool, the vertical height of the rib of which decreases toward the longitudinal axis. A geometry of this type is provided, e.g., for boring out pre-bored holes, since increased wear takes place there in an annular outer region.

According to the present invention, at least one second free face section follows the first free face section. This makes it possible for the cutting element to be widened and stabilized.

The present invention also provides that a first cutting face section follows at least one second cutting face section, so that the properties of the drilling tool can also be influenced in the region of the cutting face.

According to the present invention, an imaginary extension of the second free face section intersects the cutting element or the cutting face below the cutting edge. By orienting the second free face section in this manner, a stable basic design of the drilling tool is ensured.

Further details of the present invention are described in the drawing with reference to schematically depicted exemplary embodiments.

Figures 1a through 1c	show various partial views of a drilling tool according to the present invention;
Figures 2a through 2c	show different views of the cutting plate of the drilling tool shown in Figures 1a through 1c;
Figure 3	shows a sectional view through a traditional cutting element as an explanation of the drawings, and
Figures 4 through 14	show schematic sectional views through cutting elements of different drilling tools.

All figures are intended to be schematic figures, in the case of which the ribs, in particular, are depicted larger in size, in order to show their shape exactly.

A side view of a portion of drilling tool 1 is shown in Figure 1a. Drilling tool 1 includes a boring head 2 with a cutting element 3, designed as a cutting plate 3, and a drill twist 4. An insertion shaft, into which drill twist 4 transitions via its further, not-shown course, is not shown. This insertion shaft is designed, e.g., as a cylindrical or hexagonal insertion shaft, or as an SDS max insertion shaft or an SDS plus insertion shaft.

Figure 1b shows a top view of the boring head 2 of drilling tool 2. Figure 1c shows a side view of drilling tool 1 shown in Figure 1a, shown from arrow direction Ic. In this view, an angled surface 5 on drilling head 2 is visible, angled surface 5 being located in front of a cutting surface 6 of cutting element 3 and conveying bore dust into bore dust groove 7 of drill twist 4.

Figures 2a through 2c show cutting element 3 of the drilling tool shown in individual views in Figures 1a through 1c. Cutting element 3, which is designed as cutting plate 3, is designed symmetrical to a longitudinal axis L and has two principal cutting edges 8, 9. Due to the symmetrical design, only principal cutting edge 8 will be described in greater detail below. Principal cutting edge 8 is defined by cutting face 6 and a free face 10

which, together, form a cutting edge 11. Free face 10 is composed of a first free face section 10a and a second free face section 10b. Furthermore, cutting element 3 is characterized by a chisel edge 12. In Figure 2b, which shows a side view of Figure 2a from arrow direction IIb, first free face section 10a is designed as a convexly bulged surface or a convex bulge 13 that extends parallel to cutting edge 11. Together with an associated section of cutting face 6, first free face section 10a defines a rib 14, as viewed from a spacial perspective. A cutting plane CP is indicated in Figures 2a and 2c as an example. Cutting plane CP is intersected at a right angle by cutting edge 11.

Figures 3 through 14 show sections through cutting elements 3 that lie in a cutting plane CP, which is designed similar to cutting plane CP shown in Figures 2a and 2c. To ensure that all details of the figures can be seen, the cutting surface was not shaded in any of the figures.

To explain the terms, a sectional view through a conventional cutting element SE known from the related art is shown in Figure 3. A free face F has a free face angle α with a plane E that is perpendicular to longitudinal axis L. Furthermore, a cutting face S has a cutting face angle γ with this plane E. Together, free face F and cutting face S form a wedge angle β and define the shape of cutting edge SK.

Figure 4 shows, after the embodiments depicted in Figures 1a through 1c and 2a through 2c, a second embodiment of a cutting element 3 for a drilling tool according to the present invention. A cutting edge 11 of cutting element 3 extends along a point of intersection of a horizontal plane E with cutting element 3. Along the side of cutting edge 11, free face 10 extends in a first free face section 10a with a convexly bulged cross section, and in a second free face section 10b at a free face angle α_2. A cutting face 6 is also composed of a first, convexly bulged cutting surface section 6a and a second, straight cutting surface section 6b, which extends at an angle γ_2. First free face section 10a, which defines a rib 14 as viewed from a spacial perspective, has a vertical height H, which is measured as the distance between plane E and a further plane P extending in parallel with plane E and perpendicularly to longitudinal axis L. Plane P intersects cutting element 3 at the transition of first free face section 10a into second free face section 10b. Vertical height H of rib 14 has values ranging from 0.1 mm to 1.0

mm. Cutting element 3 has a width B_3 which, depending on the diameter of the drilling tool, can range from 1 mm to 6 mm, e.g., when a cutting plate is provided. The rib is shown enlarged in the schematic sectional view.

A third embodiment of cutting element 3 for a drilling tool according to the present invention is shown in Figure 5. Unlike the cutting element shown in Figure 4, cutting element 3 has a single-component cutting surface 6, which extends at a cutting angle γ_1 without changing direction up to cutting edge 11. A first and second free face section 10a, 10b are designed similar to cutting element 3 shown in Figure 4. An extension V of second free face section 10b in a direction of rotation d intersects cutting face 6 at a point of intersection SP that is located below cutting edge 11.

Fourth, fifth and sixth embodiments of cutting element 3 for a drilling tool according to the present invention are shown in Figures 6 through 8. The aspect shared by these three embodiments is the fact that a first free face section 10a defines a convex polygon outline 15. Sections 16, 17 of convex polygon 15 have different free face angles α_{11} and α_{12}. With all three embodiments, an extension V of second free face section 10b intersects cutting element 3 and cutting face 6 below a cutting edge 11 at a point of intersection SP. Vertical height H of rib 14 is indicated in Figure 8. Vertical height H is defined as a distance between planes E and P, with which longitudinal axis L are perpendicular and which intersect a cutting edge 11 and the transition from first free face section 10a into a second free face section 10b.

Further embodiments of cutting element 3 for a drilling tool according to the present invention are shown in Figures 9 through 14. The description of the individual embodiments will focus exclusively on the unique features of the embodiments. The embodiments according to Figure 9, as do the embodiments according to Figures 10 and 14, show a second free face section 10b with a bulged extension, the tangential extension V of which intersects a free face 6 composed of two sections 6a, 6b at a point of intersection SP below a cutting edge 11.

The cutting element according to Figure 11 has a free face section 10b that slants in the same direction as a cutting face 6.

With the tenth embodiment according to Figure 12, a first cutting face section 6a is designed as a concave bulge.

Finally, Figure 13 shows an eleventh embodiment of a cutting element 3 for a drilling tool according to the present invention, with which a first free face section 10a is designed as a convex polygon outline 15, the first section 16 of which extends parallel to a second free face section 10b. First free face section 10a and an associated first cutting face section 6a define a rib 14, as viewed from a spacial perspective, above a plane P (rib 14 is shaded for emphasis). Rib 14 has a horizontal width B that ranges from 0.2 mm to 1.0 mm.

To better explain the present invention, reference numbers are also included in the embodiments shown in Figures 4 through 14 that are not expressly referred to in the description of the particular figure. These are reference numerals that are significant for all figures in the same manner.

The present invention is not limited to the exemplary embodiments shown or described. Rather, it includes refinements of the present invention within the scope of patent claims. In particular, the present invention also provides a drilling tool, the first free face section of which is designed as a convex polygon outline with three and more sections. In terms of the free face angles of the individual sections of a convex polygon outline, the following typically applies: $\alpha_{11} < \alpha_{12} < \alpha_{13} \ldots < \alpha_{1n}$. In deviation from the exemplary embodiments shown, the present invention also provides cutting elements, the cutting edge or cutting edges of which have a polygonal shape and/or a wavy shape as viewed from above and/or the side.

The embodiment of the cutting lip according to the present invention is also provided for cutting elements that are designed without a chisel edge or a centering point. The cutting elements can also be asymmetrical in design.

Reference numerals:

1	Drilling tool
2	Boring head
3	Cutting element, cutting plate
4	Drill twist
5	Angled surface of boring head 2
6	Cutting face
6a, 6b	First and second cutting face section
7	Bore dust groove
8	Principal cutting edge
9	Principal cutting edge
10	Free face
10a, 10b	First and second free face section
11	Cutting edge
12	Chisel edge
13	Convex bulge
14	Rib
15	Convex polygon outline
16	Section of 15
17	Section of 15
α	Free face angle

β	Wedge angle
γ	Cutting face angle
CP	Cutting plane
B	Horizontal width of 14
B_3	Width of 3
E	Plane perpendicular to L
H	Vertical height of 14
L	Longitudinal axis of drilling tool 1
P	Plane perpendicular to L
SE	Cutting element
SP	Point of intersection of 6 and V
V	Extension of second free face section 10b
d	Direction of rotation of 1 and 3